To test this point the following experiment was therefore made. A little dusty air was mixed with filtered air, and put into the test receiver, and saturated with water vapour. An expansion of only 2 c.c. was made; this caused the formation of a fog. After these fog particles had settled, the air was returned to the receiver; and after a short time another 2 c.c. expansion was made, when other fog particles appeared. After this had been done a number of times, the density of the fog got less and less, and at last entirely ceased. After this an expansion of 5 c.c. was made; this produced a rainy condensation in the receiver, which appeared a number of times on successive expansions being made, getting less and less dense, and at last it also ceased entirely. After all condensation had stopped with the 5 c.c. expansion, the expansion was increased to 10 c.c., when another shower made its appearance, and after one or two expansions all condensation again ceased. After this condition was attained, an expansion of 150 c.c. was made with the pump, when scarcely one drop made its appearance.

It is concluded that in the above experiment we have distinct evidence that the *size* of the particle does affect the degree of supersaturation required to produce condensation on it. Because, though an expansion of 2 c.c. produced a supersaturation sufficient to cause more than one-half of the particles to become visible, yet it required a higher degree of supersaturation to cause condensation to take place on others. It is also concluded from the experiment that the failure of the air to keep clear, in the tests where high supersaturation was used, was not due to the presence of extremely small particles, as an expansion of 10 c.c. is practically great enough to produce a supersaturation sufficient to cause condensation on the smallest particles.

The failures in the tests not being due to the presence of extremely small particles, it is concluded that they are true cases of condensation without nuclei, similar to those referred to in a previous communication. It was thought that, if they were true cases of spontaneous condensation, they might be checked if the expansion was made slowly and free from shocks. And on the other hand any shock would tend to produce condensation in dust-free air if highly supersaturated. On trying this, it was found that no condensation took place if the stroke of the pump was made slowly and steadily, and that if done quickly, and the piston made to strike the cover of the cylinder violently, then copious showers were always produced in the dust-free air. Here, then, was the key to one of the difficulties, and accounted for the occasional increase in the number of the particles counted; many of the drops having no dust-nucleus. Failure from this cause is now entirely prevented by causing the air on its passage from the receiver to the pump to pass through a small opening, or better through a small cotton-wool filter; this checks all violent rush of air, and shocks, and keeps the filtered air perfectly free from condensation even when highly supersaturated.

Again, the failure of perfectly filtered air to keep free from condensation was frequently observed after the inside of the test receiver had been newly wetted. It looked as if the newly wetted sides had saturated the air more thoroughly, and that the condensation was due to the higher degree of supersaturation which took place when expansion was made. This class of failures was, however, traced to the manner of wetting the inside of the receiver. If it was done roughly, and the water splashed, then many nuclei were manufactured in the receiver; if it was done quietly, none, and no condensation followed. Another cause of failure was traced to a drop of water getting into the pipe by which the air entered, and the inrush of air tearing the water into fine spray, which became active centres of condensation.

As yet no great number of tests of air have been made under different conditions, natural or artificial; but in the following table will be found some of the results obtained by this method of counting.

Dust Particles in the Atmosphere.

Source of the Air.	Number per c.c.	Number per c.in.
Outside Air—Raining ...	32,000 ...	521,000
,, ,, —Fair ...	130,000 ...	2,119,000
Room	1,860,000 ...	30,318,000
,, near ceiling ...	5,420,000 ...	88,346,000
Bunsen Flame ...	30,000,000 ...	489,000,000

In the first column of the table is entered the source of the air; in the second, the number of particles per cubic centimetre; and, for the benefit of those who think in English measures, the number per cubic inch is entered in the third column. The first number in the table, for ordinary outside air, was obtained on January 25, after a wet night. The number given for fair weather is an average got when the weather was in that condition. As yet far too few measurements have been made to enable us to trace any connection between the number of particles and the weather, but it is hoped that something practical may result from observations of this kind. The first number given for the air in a room is the number counted in the air of a room where gas was burning, and taken at a height of 4 feet from the floor; the other number was counted in air drawn from near the ceiling; and the last number was got in the air collected over a bunsen flame.

The value of numbers given in the table has not been carefully considered, and they are not given as absolutely correct; great accuracy, indeed, does not seem possible, when we consider the conditions; and, further, the number is constantly varying. For this reason it has not been thought necessary to make any corrections for temperature and pressure. Though we can get with a fair degree of accuracy the number of particles in the air in the test receiver, yet in all probability the calculated numbers given in the table are rather under than over estimates, as it is difficult to manipulate air without losing much of its dust. For instance, in one hour about one half of the particles settle out of the air in the gasometer. Though the numbers do seem very large, yet so far as can be judged at present they are fairly correct, and at least represent the kind of numbers we have to deal with. It does seem strange that there may be as many dust particles in 1 cubic inch of the air of a room at night when the gas is burning as there are inhabitants in Great Britain, and that in 3 cubic inches of the gases from a bunsen flame there are as many particles as there are inhabitants in the world.

JOHN AITKEN.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Frank Smart Studentship of Botany, founded at Gonville and Caius College by Mr. F. G. Smart, M.A., M.B., and Mrs. Smart, by the transfer of £2400 Great Eastern Railway 4 per cent. Debentures, is to be awarded for the first time at the beginning of Easter Term. Candidates are to send in their names to the Master of the College, Dr. Ferrers, on or before March 20. The electors are the governing body of the College, acting after consultation with the Professor and the Reader of Botany for the time being in the University. The Studentship is to be open to all members of the University who have taken honours in the first part of the Natural Sciences Tripos, and of not more than five years' standing; but the elected Student must become a member of Gonville and Caius. No competitive examination is to be held for awarding the Studentship. The Student is to apply himself to original investigation in botany, and must be able to show that he is doing so at any time, on penalty of forfeiting the Studentship. The Studentship is to last two years, but may under special circumstances be prolonged for one year more. The regulations of the Studentship are only to be changed, after the death of Mr. and Mrs. Smart, by consent of the Council of the Linnean Society of London. A prize of £6 in books is to be given out of the interest of the fund to the undergraduate student of Caius College who shall distinguish himself most in botany at the annual College examination.

The collection of British birds' eggs made by the late Mr. J. P. Wilmot, of Trinity College, containing a specimen of the great auk's egg, and other specimens figured in Hewitson's "British Oology," has been presented to the University by Lady Caroline and Mr. C. H. Russell, in memory of Mr. George Lake Russell, Lady Caroline's late husband.

Plans are submitted for the proposed new plant-houses at the Botanic Garden, to cost £2760, and of a laboratory in the garden, to cost £250.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 9.—"The Small Free Vibrations and Deformation of a Thin Elastic Shell." By A. E. H. Love, B.A., Fellow of St. John's College, Cambridge.

In this paper the method employed by Kirchhoff and Clebsch for the treatment of a thin plane plate is applied to the case of a thin shell, or plate of finite curvature. It is proved (1) that only for an inextensible spherical surface is the potential energy-function the same function of the changes of principal curvature as for a plane plate; (2) that in general the shell cannot vibrate in such a manner that no line on the middle-surface is altered in length, because this condition makes it impossible to satisfy the boundary conditions which hold at a free edge; (3) that surfaces of uniform curvature with no bounding edges are the only ones which admit of purely normal vibrations; and (4) that vibrations in which the displacement is purely tangential are possible on all shells whose middle-surfaces are surfaces of revolution bounded by small circles. The possible modes of vibration of the spherical and cylindrical shell receive special discussion. The equilibrium of the shell is also considered.

Linnean Society, February 2.—Mr. Carruthers, F.R.S., President, in the chair.—The President called attention to the loss which the Society had sustained by the deaths of Prof. Asa Gray, Prof. Anton De Bary, and Mr. Irwine Boswell (formerly Syme) which had occurred since the date of the last meeting, and gave a brief review of the life and labours of each.—Mr. C. T. Druery exhibited a collection of abnormal British ferns, and made some remarks on the extraordinary number of named varieties which had been recognized, and which now required to be carefully examined and compared, with a view to some systematic arrangement of them. A discussion followed, in which the President, Mr. J. G. Baker, F.R.S., Dr. Murie, and others took part.—Dr. Amadeo exhibited and made some observations on a new species of *Tabernæmontana*.—A long and interesting paper was then read by Mr. Henry T. Blanford, F.R.S, on the ferns of Simla, based upon a collection which he had himself made there, "not much below 4500 feet, nor above 10,500 feet." His remarks were illustrated by a map, and by an exhibition of a number of the more noticeable ferns collected, many of which were extremely beautiful. Criticisms were offered by Mr. C. B. Clark, F.R.S., Mr. Gamble (Conservator of Forests, Northern Circle Madras) and Dr. William Schlich (Inspector-General of Forests to the Government of India).—A paper was then read by Mr. H. J. Veitch, on the fertilization of *Cattleya labiata*, var. *Mossiæ*, in which the author detailed an elaborate series of observations undertaken with the object of detecting, if possible, the act of fertilization of the ovules, to determine the time that elapses between pollination and that event, and to trace the development of the ovules into perfect seeds. After explaining the structure of the sexual apparatus of *Cattleya labiata* with the aid of drawings showing the separate parts, the processes following pollination were dealt with, first from the development of the rudiment into the perfect ovule, and then the ripening of the ovules into seeds, these processes being also illustrated by drawings made at particular stages. A discussion followed, in which Mr. J. G. Baker, Mr. H. N. Ridley, and others took part, and to their inquiries for further particulars Mr. Veitch replied.—The next paper, by Mr. Joseph S. Baly, contained descriptions of new species of *Galerucinæ*, and being of a technical character was taken as read.

Entomological Society, February 1.—Dr. D. Sharp, President, in the chair.—The President nominated Sir John Lubbock, Bart., M.P., F.R.S., Mr. Osbert Salvin, F.R.S., and the Right Hon. Lord Walsingham, F.R.S., Vice-Presidents for the session 1888 to 1889.—Mr. F. Pascoe exhibited a species of the Hemipterous genus *Ghilianella*, which he found at Pará with the young larva. He said it was the only occasion he ever saw the species with the larva, which was new to Mr. Bates.—Dr. Sharp exhibited some insects collected by Mr. A. Carson on Kavalla, an island in Lake Tanganyika. The Coleoptera were nearly all well-known species, exemplifying the fact that many of the commoner insects of tropical Africa have wide distribution there, some of these species being common to both Natal and Senegal. The most remarkable of the insects was a large Lepidopterous caterpillar.—Mr. Champion exhibited specimens of *Casnonia olivieri*, *Œdichirus unicolor*, *Paussus favieri*, *Colydium elongatum*, *Endophlœus spinulosus*, *Hetærius arachnoides*, *Pseudotrechus mutilatus*, *Singilis bicolor*, *Phyllomorpha laciniata*, recently collected by Mr. J. J. Walker, R.N., at Gibraltar, Tetuan, and Tangier.—Mr. R. South exhibited a remarkable variety of *Polyommatus phlœas*, caught by him in North Devon in 1881.—Mr. R. W. Lloyd exhibited a living specimen of a species of *Ocnera* from Ispahan.—Mons. A. Wailly exhibited, and read notes on, a number of cocoons of *Antheræa assamensis*, *A. roylei*, *Actias selene*, and *Attacus ricini*, lately received from Assam; also a number of nests of cocoons of *Bombyx rhadama*—the silk of which is used by the Hovas in the manufacture of their stuffs called "Lambas"—from Madagascar.—Captain H. J. Elwes read a paper on the butterflies of Sikkim, the result of many years' collecting. He said he had been enabled to complete his observations during the enforced delay at Darjeeling of Mr. Macaulay's Mission to Thibet, of which he was a member. He stated the number of species occurring in this district to be about 530, which is greater than the number hitherto found in any other locality in the Old World. Of these the greater part only occur in the hot valleys at an elevation of 1000 to 3000 feet, and these are for the most part of a purely Malayan character, whilst those found in the middle zone are in many cases peculiar to the Himalayas; and the few species from the alpine parts of the country at 12,000 to 16,000 feet are of a European or North Asiatic type. An important feature in this paper was the numerous observations taken on the habits, variation, seasons of appearance, and range of altitude of the various species, for which the author said he was largely indebted to Herr Otto Möller, of Darjeeling. The paper concluded with an analysis of the species and genera compared with those found in the North-West Himalayas and in the Malay Peninsula. Mr. J. H. Leech, Dr. Sharp, Captain Elwes, and others took part in the discussion which ensued.

Zoological Society, February 7.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of January.—Mr. E. G. Loder exhibited and made remarks on a very large African Elephant's tusk, which weighed 180 pounds, and was, as he believed, the largest tusk hitherto authentically recorded.—Mr. A. Thomson exhibited a living specimen of the larval form of Stick-Insect (*Empusa pauperata*) from the Insect House.—Mr. G. A. Boulenger, read the third of his series of contributions to the herpetology of the Solomon Islands. The collection now described have been obtained by Mr. C. M. Woodford during a visit to the islands of Guadalcanar and New Georgia. The author observed that though the collection contained over 200 specimens, only four species were thereby added to the herpetological list of the Solomons, showing that our knowledge of that fauna was approaching completion.—A communication was read from Mr. Arthur G. Butler, containing descriptions of some new Lepidoptera from Kilima-njaro. Some of the specimens described had been collected by the late Bishop Hannington, and others by Mr. F. J. Jackson.—Mr. Frank E. Beddard read a paper upon certain points in the visceral anatomy of the Lacertilia. The paper dealt principally with *Monitor*, in which the presence of a peritoneal fold covering the abdominal viscera and separating them from the lungs was referred to; this membrane was compared with a corresponding structure in the Crocodilia.—Mr. D. D. Daly gave an account of the Birds'-nests Caves of Northern Borneo, of which no less than fifteen were now known to exist in different parts of the North Bornean Company's territories. Most of these were situated in limestone districts in the interior, but two of them were in snadstone formations near the sea-coast.—A communication was read from Mr. R. Bowdler Sharpe, containing the description of a new species of Tyrant-bird of the genus *Elainea*, from the Island of Fernando Noronha. This was proposed to be called *E. ridleyana*, after Mr. H. N. Ridley, who had obtained the specimens during his recent exploration of that island.—Mr. Osbert Salvin, F.R.S., read a note on *Ornithoptera victoriæ*, from Guadalcanar Island of the Solomon Group, and pointed out the characters which separated this species from a closely allied form of the Island of Maleite, proposed to be called *O. reginæ*.

Geological Society, February 8.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—On some remains of *Squatina cranei*, sp. nov., and the mandible of *Belonostomus cinctus*, from the Chalk of Sussex, preserved in the collection of Mr. Henry Willett, of the Brighton Museum, by Mr. A. Smith Woodward.—On the history and characters of the genus *Septastræa*, D'Orbigny (1849), and the identity of its type species with that of *Glyphastræa*, Duncan (1887), by Dr. George Jennings Hinde.—On the examination of insoluble residues obtained from the Carboniferous Limestone at Clifton, by Mr. E. Wethered.

Royal Microscopical Society, February 8.—Annual Meeting.—The Rev. Dr. Dallinger, F.R.S., President, in the chair.—The Report of the Council was read, showing a further increase in the number of Fellows, and in the revenue of the

Society.—Mr. Crisp referred to the great loss the Society had sustained by the death of Dr. Millar, who had always taken a lively interest in the affairs of the Society, and for nearly thirty years had been a member of Council.—Dr. Dallinger delivered his annual address.

PARIS.

Academy of Sciences, February 20.—M. Janssen in the chair.—Third note on the doctrine of probabilities as applied to target practice, by M. J. Bertrand. The object of this paper, which has been prepared at the request of several artillery officers specially interested in the subject, is to present in a form capable of immediate application the results already arrived at as set forth in the previous communications.—On the species of Proneomenia on the coast of Provence, by MM. A. F. Marion and A. Kowalevsky. In a previous note the authors described a new genus of Solenogaster from the Gulf of Marseilles differing from the Proneomenia by its thorny integument. Here he describes four distinct species of the genus Proneomenia which occur on the coast of Provence, and which present features by which they may be readily distinguished from *P. sluiteri* described by Hubrecht. These species, none of which exceed 15 mm. in length, are respectively named *P. vagans*, *P. caulini*, *P. desiderata*, and *P. aglaophenicæ*. Incidental reference is made to a fifth species (*P. gorgonophila*) discovered on the coast of Algeria.—Observations of the new planet Charlois, 272, made at the Observatory of Algiers with the 0·50 m. telescope, by MM. Rambaud and Sy. The observations for right ascension, declination, apparent position, &c., extend over the period February 10–11.—Observations of the same planet are also recorded for February 8–13 made at the Observatory of Marseilles with the Eichens equatorial, by M. Borrelly.—Permanent deformations and thermodynamics (continued), by M. Marcel Brillouin. The chief subjects here discussed are the principle of equivalence, specific and latent heats, and the differential relations between the specific heats.—On the electrostatic attraction of electrodes in water and attenuated solutions, by M. Gouy. The theory of the propagation of electricity in the permanent state suggests the presence of free electricity during the passage of the current, not only on the outer surface of the conductors, but also on the surface separating two conductors of different specific resistance, the electric force necessarily having different values on either side of this surface. The author here endeavonrs to ascertain whether this hypothetic layer of free electricity on the contact surface might be capable of exercising any electrostatic action. For this purpose he studies the case of two metallic conductors placed in a moderately conducting liquid and maintained by a pile with different potentials, in order to determine how far they may be acted upon by appreciable forces. His experiments seem to show that these forces really exist, and are in fact much more considerable than could have been foreseen.—On the coefficients of proportionality in radiating heat, by M. L. Godard. The experiments here described seem to show that the coefficients of proportionality given by the study of the diffusion of heat, and confirmed by the spectro-photometric analysis of coloured substances, are the same as the numbers obtained by M. L. Mouton in his researches on the distribution of heat in the normal spectrum of the sun.—Preparation and properties of a bi-hydrofluate and of a tri-hydrofluate of fluoride of potassium, by M. H. Moissan. While hydrochloric acid yields with difficulty the hydrochlorates of chlorides, hydrofluoric acid combines readily with the neutral fluorides to produce hydrofluates of the general formula KFl, HFl. But these compounds, including 1 equivalent of hydrofluoric acid, are not the only ones that may be obtained, at least with the alkaline metals. The author has succeeded in preparing two new combinations containing 2 and 3 equivalents of acid for 1 of fluoride of potassium. These ombinations, abounding in hydrofluoric acid, and capable of being kept in the fluid state at temperatures ranging from 65° to 105° C., may perhaps under certain conditions enable the hydrofluoric acid to react readily on a certain number of organic or mineral compounds.—On a new reagent of the products of saponification of cotton-oil, by M. Ernest Milliau. The chemical reagent here described, which is not observed in the fatty acids of olive-oil, is so sensitive that by its means the presence may easily be detected of 1 per cent. of cotton-oil in olive-oil. All risk of error is removed, as the operation is effected, not on the oil itself, but on the fatty acids free from all impurity. Science has thus supplied the long sought-for means of infallibly detecting any adulteration of olive-oil by cotton-oil in the proportion of from 5 to 20 per cent., as is usually practised in the trade.—On the essence of lavender, by MM. R. Voiry and G. Bouchardat. The results of the analysis of this essence differ in some respects from those hitherto published. The authors have determined the presence of an oxygenated compound identical with eucalyptol, and the almost complete absence of carburets of hydrogen.—The sardine fisheries on the west coast of France in 1887, by M. Georges Pouchet. Last year was characterized by an extreme abundance of sardine on the French fishing-grounds, at the very time when the most opposite reasons were being advanced to account for a supposed gradual disappearance of the species from the French waters. On this point nothing positive can be asserted in the absence of any accurate knowledge of the migrations and spawning-grounds of the sardine.—On the Quaternary station of La Quina, Charente, by M. Emile Rivière. This station of prehistoric man, which lies near the banks of the Voultron in the Canton of La Valette, has recently been carefully explored by the author, who agrees with M. Chauvet in assigning it to the Mousterian (reindeer) epoch. The animal remains include the cave-bear, jackal, wild cat, horse, *Bos primigenius*, *Cervus elephas*, and especially the reindeer, in great abundance. No human bones were found, but there is an abundance of chipped flints, some very fine, and evidently worked on the spot.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Navigation and Nautical Astronomy: W. R. Martin (Longmans).—The Method of Creation: H. W. Crosskey (Sunday Sch. Assn.).—Elementary Physiography: J. Thornton (Longmans).—Life in Corea: W. R. Carles (Macmillan).—Discursive Essays on the Phenomena of the Heavens and Physical History of the Earth, Part 1 (London Literary Society)—Technological Dictionary, 3 vols.. English, German, and French: Röhrig and Schiller (Trübner).—Emin Pasha in Central Africa (Philip).—Das Antlitz der Erde, vol. ii.: E. Suess (Tempsky, Wien).—Jahrbuch der k. k. Geologischen Reichsanstalt, Jahrg. 1887, xxxvii. Band, 2 Heft; Abhandlungen der k k. Geologischen Reichsanstalt, Jahrg. 1887, xi. Band, 2 Abthg. (Wien).—Industrial Instruction: R. Seidel (Heath, Boston).—The Manual Training School: C. M. Woodward (Heath, Boston).—A Pocket-book of Electrical Rules and Tables, 5th Edition: Munro and Jamieson (Griffin).—ii. Jahresbericht (1886) der Ornithologischen Beobachtungstationen im Königreich Sachsen: Dr. A. B. Meyer and Dr. F. Helm (Dresden).

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